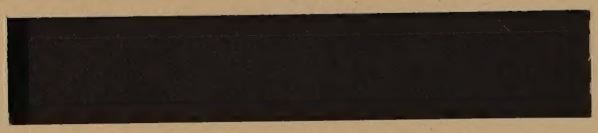
OPERATING MANUAL
MODEL 10458V
TWT AMPLIFIER

INSTRUMENT COPY

MCL/INC
DESIGNERS AND MANUFACTURERS OF RF COMPONENTS AND SYSTEMS
TEN NORTH BEACH • LA GRANGE ILLINOIS 60525 • 312-354-4350



INSTRUMENT SHOP

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TITLE:

OPERATING MANUAL

MCL 10450 - 10460

TWT AMPLIFIERS

TITLE:

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1.0 GENERAL

The purpose of this document is to outline the operating procedures for the MCL 20 Watt TWT Amplifier series.

THIS DOCUMENT IS NOT INTENDED AS A REPAIR MANUAL DUE TO THE EXTREMELY HAZARDOUS VOLTAGES INVOLVED.

Schematic Diagram 32D1362 or 32D1363 is used as a reference for this manual.

2.0 PRECAUTIONS

2.1 Observe AC input power requirements as outlined in Section 3.0.

2.2 Note the maximum load VSWR indicated on the front panel of the TWT Amplifier. The load VSWR is different for various tube types used and therefore is not included in this manual. Never allow the H.V. to be on if the RF input or output c onnections are unterminated.

2.3 To prolong tube life, do not allow the amplifier to remain in Standby for periods greater than 1/2 hour. It is best to keep the unit in transmit or shut off completely.

2.4 CAUTION: Lethal voltages are present during operation. Use only insulated tools in making adjustments with the high voltage on.

Dangerous voltages are also present during Standby conditions. Observe extreme caution in making any internal adjustment.

3.0 ELECTRICAL SPECIFICATIONS

3.1 AC input 115V/230V ±10%, 60 Hz, 6A max.

3.2 Input and output impedance 50 ohm. VSWR dependent upon the tube type used.

3.3 Helix, Collector and Fil P.S. are regulated.

3.4 Frequency RF power input and output is dependent upon model number and tube type used.

4.0 THEORY OF OPERATION

4.1 AC Power

The AC input of 115V or 230V, as determined by the back panel selector switch S105, is applied to J108. Fuses F101 and F102 located on the rear panel, protect the unit from AC overload. The AC control function is provided by PC board 1005-011-305, connected to J106. When the Main On switch S101 is depressed, blower B101 and Heater Regulator Assy. 1005-011-301 are activated. AC is applied to a time-delay circuit which in approximately 3 minutes will place the unit in a standby condition. This allows ample time to heat the cathode of the TWT. After standby operation is achieved, the HV On switch S104 may be activated. To revert to a standby condition, depress the Standby switch S102. Depressing the Main On switch will remove AC power from the unit.

4.2 HV-DC Regulator

The output of the T102 is rectified by CR101, filtered by C102, and is regulated by PC Assembly 1005-003-301 and the pass tube V101.

4.3 Heater Regulator

The PC card 1005-008-301 is a heater regulator and provides a stable DC voltage to the heater of the TWT tube.
NOTE: THIS SUPPLY IS AT A NEGATIVE VOLTAGE OF 1400 TO 4000 VOLTS DEPENDENT UPON THE TWT TUBE USED. DO NOT ADJUST THE HEATER VOLTAGE WHILE THE UNIT IS IN A HV "ON" CONDITION.

4.4 Cathode "Turn-On"

Upon initial application of the High Voltage, the anode is clamped to the cathode through K501. When the cathode potential reaches 70 to 90% of its operating value, K501 will open and return the anode to its normal potential, allowing beam current to flow. This sequencing is provided to prevent the TWT from de-focusing and drawing excessive current.
NOTE: HV IS PRESENT ON THIS BOARD DURING OPERATION

4.5 Resistor Assembly

The resistor assembly 1005-010 provides an error signal to the voltage regulator sense input to provide the HV regulation and also controls the turn-on level of relay K501.
NOTE: HV IS PRESENT ON THE BOARD DURING OPERATION

4.6 Over-Current Protection

Relay board 1005-011-301 provides Helix over-current protection. If the Helix current rises above the set value, relay K403 will open the interlock circuit and the unit will revert to a standby condition.

4.7 Temperature Interlocks

A thermal interlock is provided on the TWT tube heat sink and will open the interlock line if an air restriction or failure occurs. The tube overheats due to excessive current or the ambient inlet air temperature reaches a level that will not properly cool the tube. When the condition is rectified and the tube cools to a temperature below the limit of the sensing switch, HV operation can again be achieved.

4.8 Chassis Interlock

When the top cover is removed, S108 will open, causing a Standby condition and preventing the HV from being applied. This switch

TITLE:

4.8 Chassis Interlock (con't)

can be defeated for servicing by pulling up on the actuating pin until a click is heard and the pin remains up. S104 may now be depressed and the HV will be activated. USE EXTREME CAUTION IN MAKING INTERNAL MEASUREMENTS OR ADJUSTMENTS.

4.9 Metering

A panel meter M101 is provided to measure Helix and beam (cathode) current. The meter reads directly for Helix current and readings must be multiplied by 10 for beam current measurement. S107 on the panel selects the function of the meter. The normal values of current will differ with various tube types and is noted in the test data.

5.0 GAIN CONTROL

5.1 The front panel gain control (R106) will provide approximately 6 db of control over the TWT.

6.0 RF TESTING

Refer to the block diagram in paragraph 6.0 for the test connections. This will vary to some extent dependent upon the frequency range and available equipment. Apply an input signal through the input directional coupler to the system. The power level is monitored by the power meter connected to the forward port of the directional coupler. Output power is monitored through the directional coupler on the output line of the TWTA. Measure output power and gain at the rated power of the TWT (20W) vs. frequency, and record on the data sheets in paragraph 9.0. Record also the Helix current under drive. Special tests will be made as required per individual unit.

7.0 RF TESTING BLOCK DIAGRAM

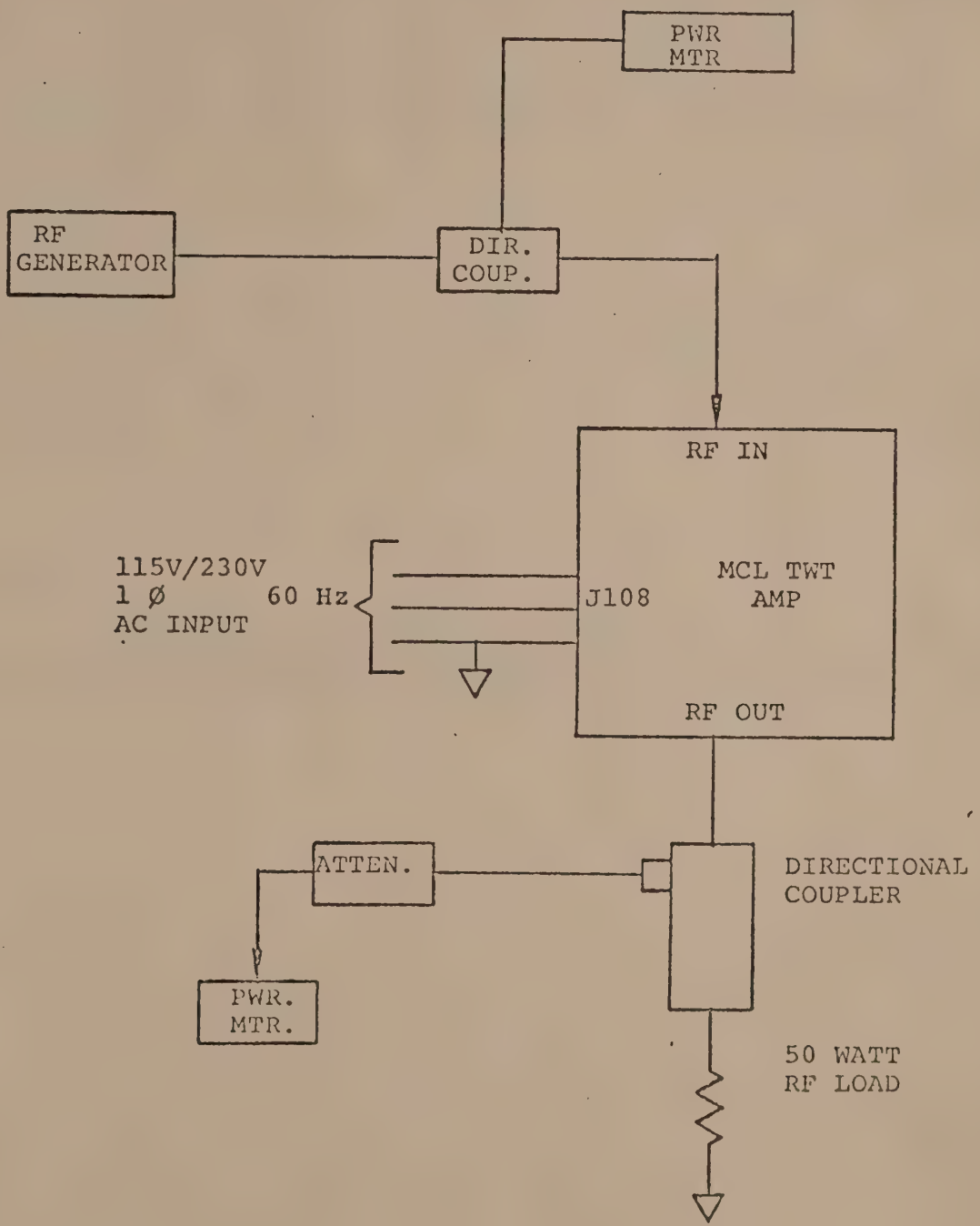
See Sheet 7 of 9.

8.0 SERVICE

During the warranty period, the unit should be returned to MCL for service. Unauthorized repairs will void the warranty. After this period expires, maintainance, calibration, and repair may be done at the customers facility or the unit may be returned to MCL for such service and will be billed to the customer. It is recommended that TWT tube replacement be effected at MCL facilities.

TITLE:

7.0 RF TESTING BLOCK DIAGRAM



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9.0 WARRANTY

Under recommended use and service, all MCL products are warranted against defects in material and workmanship for nine (9) months from the date of original shipment. Material returned after 90 days of the original shipping date will be repaired on a pro-rata basis. MCL's obligation is limited to repairing or replacing at our plant , products which prove to be defective during the warranty period. Tubes. transistors, and other solid state devices are covered by the respective manufacturer's warranty which applies from the date of shipment of the unit from MCL.

MCL is not liable for consequential damage resulting from the use of MCL equipment.

There will be no charge for repair of units under warranty except non-authorized shipping charges. In the event that responsibility for repair lies with the customer, customer will be charged for the cost of re-testing, repair and shipment. Estimates of charges will be supplied before work begins.

CLAIM FOR DAMAGE IN SHIPMENT:

Your unit should be inspected and tested as soon as it is received. Claims for damage should be filed with carrier.

SHIPPING:

Upon receipt of shipping instructions, forward the unit to the destination indicated. For non-warranty service, the unit must be shipped prepaid.

9.1 VSWR PROTECTION OPTION

All standard MCL travelling wave tube amplifiers are protected against high VSWR terminations when equiped with the high VSWR protection option. This option consists of a three port circulator and associated low reflection termination. The circulator is connected between the TWT output connector and the amplifier output. High VSWR reflections from a poor amplifier termination are then absorbed by the protection circuit termination. Although the protection circuit components are rated for 100% reflections at the maximum amplifier power level, long periods of operation without a termination or a short are not recommended.

10.0 TEST DATA

CATHODE VOLTAGE	-3250	V
ANODE VOLTAGE	0	V
HEATER VOLTAGE	6.3	V
WARM-UP TIME	120	SEC
QUIESCENT HELIX CURRENT	1.0	MA
QUIESCENT CATHODE CURRENT	85	MA
DRIVEN HELIX CURRENT	2.5	MA
AC LINE CURRENT	6.0	A

FREQUENCY MHz	RF INPUT MILLIWATTS	RF OUTPUT WATTS	GAIN DB
8.0	.005	20	66.0
8.5	.006	20	65.2
9.0	.006	20	65.2
9.5	.006	20	65.2
10.0	.006	20	65.2
10.5	.010	20	63.0
11.0	.015	20	61.2
11.5	.018	20	60.4
12.0	.042	20	56.7
12.4	.063	20	55.0

Tested: 10/6/75

varian

TEST PERFORMANCE SHEET

TRAVELING WAVE TUBE
TUBE TYPE NO. VTX-6180 /J1
SERIAL NO. 4J3 DATE 12-20-74
Page 1 of 1

#2 TWT ACCEPTANCE TEST DATA

Job 33584

CUSTOMER:

OPERATING CONDITIONS[1]

TWT TEST	SYMBOL	MIN	MAX	RESULT	UNITS
Heater Voltage[2]	Ef	---	---	6.3	V
Heater Current	If	0.8	1.10	1.0	A
Helix Voltage (Label Value)	Ew	3100	3300	3250	Vdc
Helix Current (1) No Drive	Iw	---	10	1.2	mAdc
Helix Current (2) Sat Drive at 8 GHz	Iw	---	10	3.6	mAdc
Collector Voltage	Eb	1500	Ew	1600	V
Cathode Current	Ik	80	95	94	mAdc
Anode Voltage	Ec	Same as	Ew	3250	Vdc
Anode Current	Ic	---	1	0.45	mAdc
Power Output: Saturation	Po	43	---	See Table	dBm
Gain at 43 dBm (20w) Output	G	54	---	See Table	dB

1. Voltages are with respect to cathode
2. If dc heater voltage is used on this tube, the heater-cathode must be positive with respect to the heater.

Freq. (GHz)	Sat Po (dBm)	Gain At 43 dBm (dB)
8.0	45.1	68.1
8.5	44.8	68.5
9.0	44.9	68.5
9.5	45.1	69.5
10.0	44.7	66.0
10.5	44.5	66.3
11.0	44.3	65.1
11.5	44.9	64.5
12.0	44.6	61.6
12.4	44.1	60.4

LEAD CONNECTIONS

Cathode	-	Green
Heater Cathode	-	White
Heater	-	Yellow
Anode	-	Red
Collector	-	Gray
Helix	-	Brown
Base	-	Brown

TUBE TYPE	OUTLINE DRAWING NO.
VTX-6180H1	D 016560
VTX-6180J1	C 046133

TESTED BY: E Cullham DATE: 12-20-74 VARIAN QA:

$R_{DEPRESSION}$

$$\frac{1650\ V}{.90\ MA} = 18.333\ K$$

148.5 WATTS

T101
1005-009

S101

L.Y.

LY

DS101

X

Y

115V
230V

F101 6A
F102 3A
F103 5A
F104 3A

S105

B101

BLUE

WHITE

RED

C105
1 mf
370 VDC

T102
1005-006

C9 10V

R110
100Ω

R111
150Ω

R101
39K

C101
.0047

R105
22
MΩ

C102
2 mf

R102
100Ω

V101
4X150A

C103
0.5 μF

T103
1005-007

R103
470Ω

R104
1KΩ

X1

X2

S106
NOO THERM
SWITCH
NC

START

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	ORIGINAL	7-24-73	
B	ADD R511, R111, CR6 (NOTE 3)	8-9-73	
C	DS102 WAS DS3, DS101 WAS DS102, NOTES 1-3	9-12-73	
D	RELOCATED TP501	7/8/73	
E	3A WMS 25A	2-22-74	
F	REVISED	3-15-74	
G	CORRECTED PER 3535,600	7-24-74	

J102

CR301

A

2

1 (YEL)

F301

C301
1000 uf

HEATER ASSY.
1005-008-301

Q301
2N5496

R301
20Ω

C302
10uf

Q302
2N5794

Q303
2N5192

CR302
IN4007

R302
200Ω

R303
470Ω

R304
.33Ω

CR303
IN5349

J301 BRN
(NOTE 1)

J302
YEL.
(NOTE 1)

C501 47pf

R512 R511 R510 R509 R508 R507 R506 R505 R504 R503 R502 R501

R517 R518 R519 R520 R521 R522 R523

C502
.0047uf

R513

R514

R515

R516

K501

R

N

P

K

A

V

M

S

GAIN
R100

TP501

J101

INTENSITY

FOCUS

J102

CRT

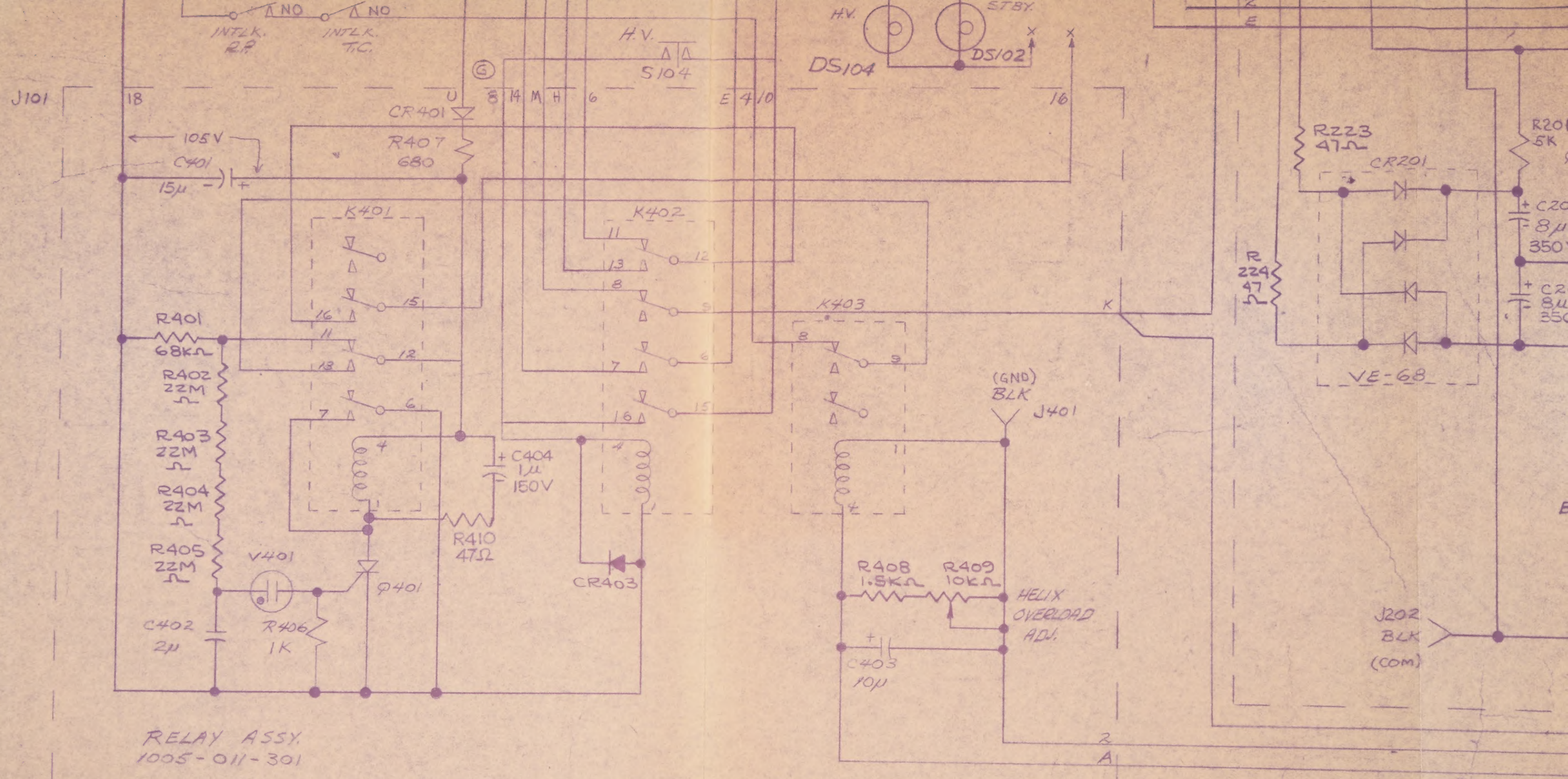
TB101
ANODE

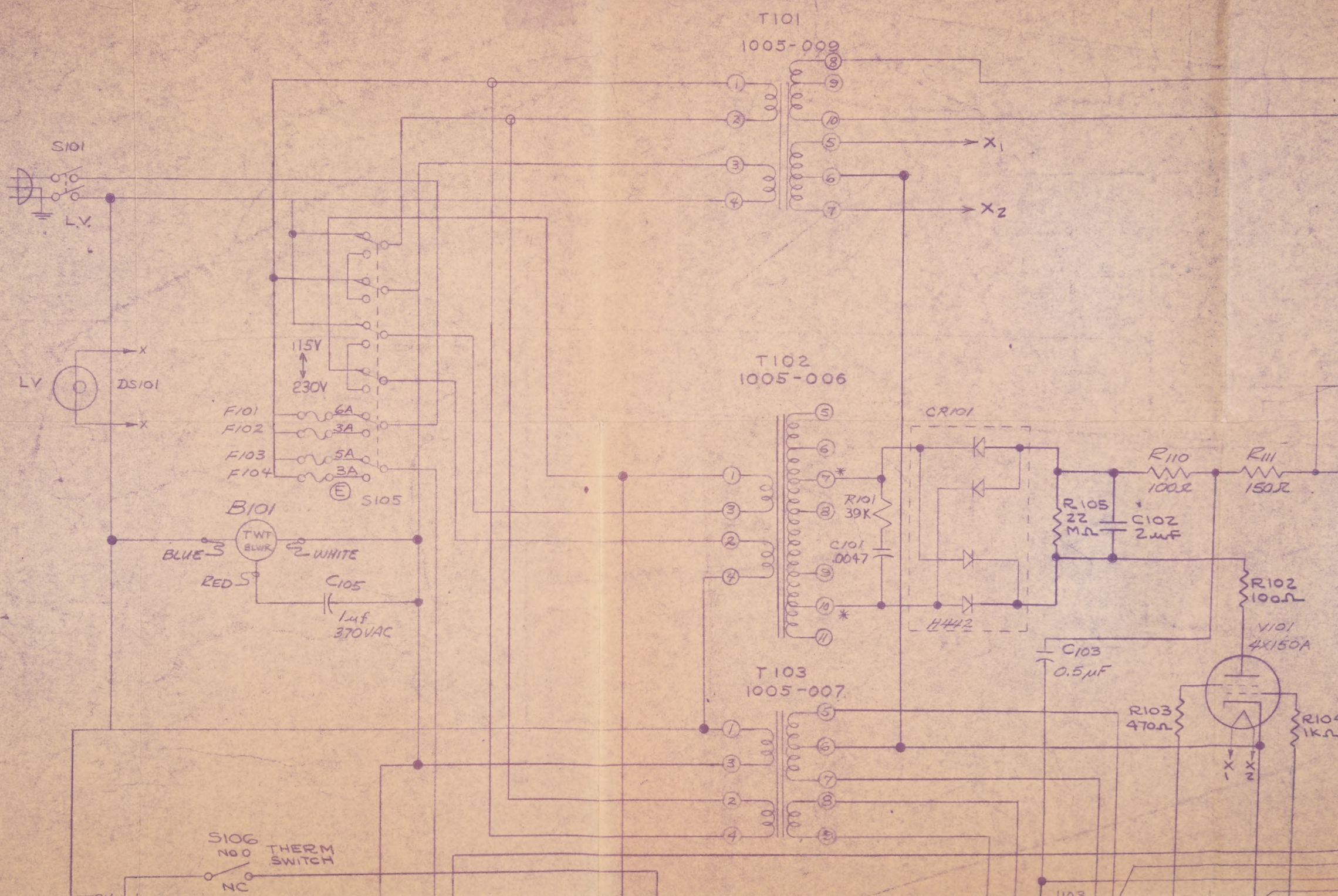
VIDEO

HEATER

COIL

TB101


NO
INTLK. R.P.
NO
INTLK. T.C.
H.V.
S104
H.V.
STBY.
DS104
DS102
J101
18
U
CR401
8 14 M H 6
E 4/10
16
105V
C401
15μ
R407
680
K401
K402
K403
R401
68kΩ
R402
22M
R403
22M
R404
22M
R405
22M
C402
2μ
R406
1K
V401
P401
R410
47Ω
C404
1μ
150V
CR403
(GND)
BLK
J401
R408
1.5KΩ
R409
10KΩ
HELIX
OVERLOAD
ADJ.
C403
10μ
R223
47Ω
CR201
R224
47Ω
VE-68
J202
BLK
(COM)
RELAY ASSY.
1005-011-301


T101
1005-009
S101
L.V.
LV
DS101
X
X
115V
230V
F101
F102
F103
F104
6A
3A
5A
3A
S105
B101
TWT BLWR
BLUE
WHITE
RED
C105
1μf
370VAC
T102
1005-006
CR101
R101
39K
C101
.0047
H442
R110
100Ω
R111
150Ω
R105
22
MΩ
C102
2μF
R102
100Ω
V101
4X150A
C103
0.5μF
T103
1005-007
R103
470Ω
R104
1KΩ
X1
X2
S106
NO
NC
THERM
SWITCH
X1
X2

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